INSTRUCTION MANUAL

LOW NOISE
TUNABLE
VHF
PREAMPLIFIER
AP-501R

ELECTRO INTERNATIONAL, INC.

MP MASTER
MA30061

INSTRUCTION MANUAL

FOR

AP-501R VHF

PREAMPLIFIER

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ELECTRO INTERNATIONAL, INC.
P. O. Box 391
Annapolis, Maryland

WARRANTY

ELECTRO INTERNATIONAL, INC., warrants each product of its manufacture to be free from defects in material and workmanship for a period of one year after delivery to the original purchaser. In equipment utilizing major vendor items, such as solid state devices, vacuum tubes or crossbar switches, the vendor's warranty will apply. Liability under this warranty consists solely of servicing, adjusting, and/or the replacement of defective parts on any product returned to ELECTRO INTERNATIONAL, INC., for this purpose with transportation charges prepaid. Permission from ELECTRO INTERNATIONAL, INC., or their authorized representative must be obtained before any product may be returned for any reason. Service or shipping information will be supplied upon notification of the difficulty encountered and the model and serial number of the instrument in question. This warranty is void under any of the following conditions:

In products using mechanical devices, if these devices are not lubricated or cleaned as specified.

Product stored or operated under ambient conditions other than those specified.

Unauthorized modification of product.

Damage incurred under other than normal operation and/or maintenance conditions.

No further guarantee or warranty is suggested or implied.

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SECTION 1 - GENERAL INFORMATION

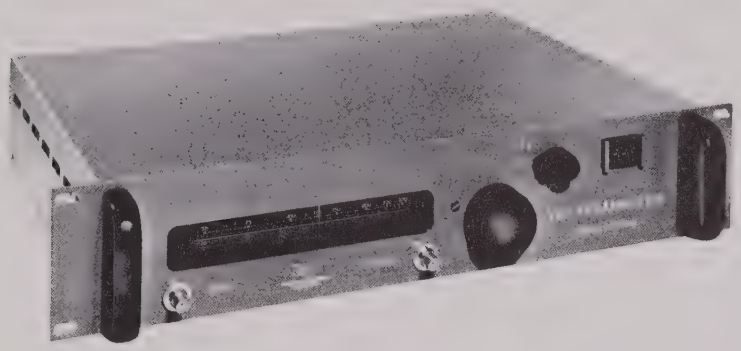


Figure 1-1 Low Noise Tunable VHF Preamplifier, AP-501R

1-1 APPLICATION

Covering the frequency range from 30 to 300 mc, this preamplifier is designed to satisfy low noise requirements in narrow-band applications.

1-2 DESCRIPTION

The unit is compact, featuring solid state power, and low-noise triodes. When used with commercially available radio-frequency interference meters, the AP-501R provides an increase in sensitivity and overall improvement of the noise figure.

1-3 FEATURES

Low noise figure
High gain
Increased sensitivity
Calibrated tuning dial
Internal solid state power supply
50-ohm impedance

1-4 SPECIFICATIONS

Frequency Range	30-300 mc; 2 bands: A=30-70 mc B=55-300 mc
Gain	23 db (nominal) Minimum (± 2 db)
Noise Figure	4.5 db maximum (less than 3.5 db below 250 mc)
Bandwidth (3 db)	Band A, (30-70 mc) 2 mc Band B, (55-300 mc) 4 mc at 55 mc, 5 mc at 300 mc
Impedance (Input and output)	50 ohms (nominal)
Input and Output Connections	Type BNC (connections may be made at either front or rear panel)
Power	95-125 VAC, 54-66 cps, 0.52 amps
Dimensions	Rackmounting, 19" x 3-1/2" (requires 16" behind front panel)
Weight	20 lbs.

2-1 R. F. AMPLIFIER STAGES

The AP-501R VHF Preamplifier is comprised of two electrically identical stages which are intended for ultimate connection in cascade, depending on which stage exhibits the lower noise figure for use as the input stage. For purposes of circuit analysis a schematic diagram of one of the stages is shown in figure 2-1.

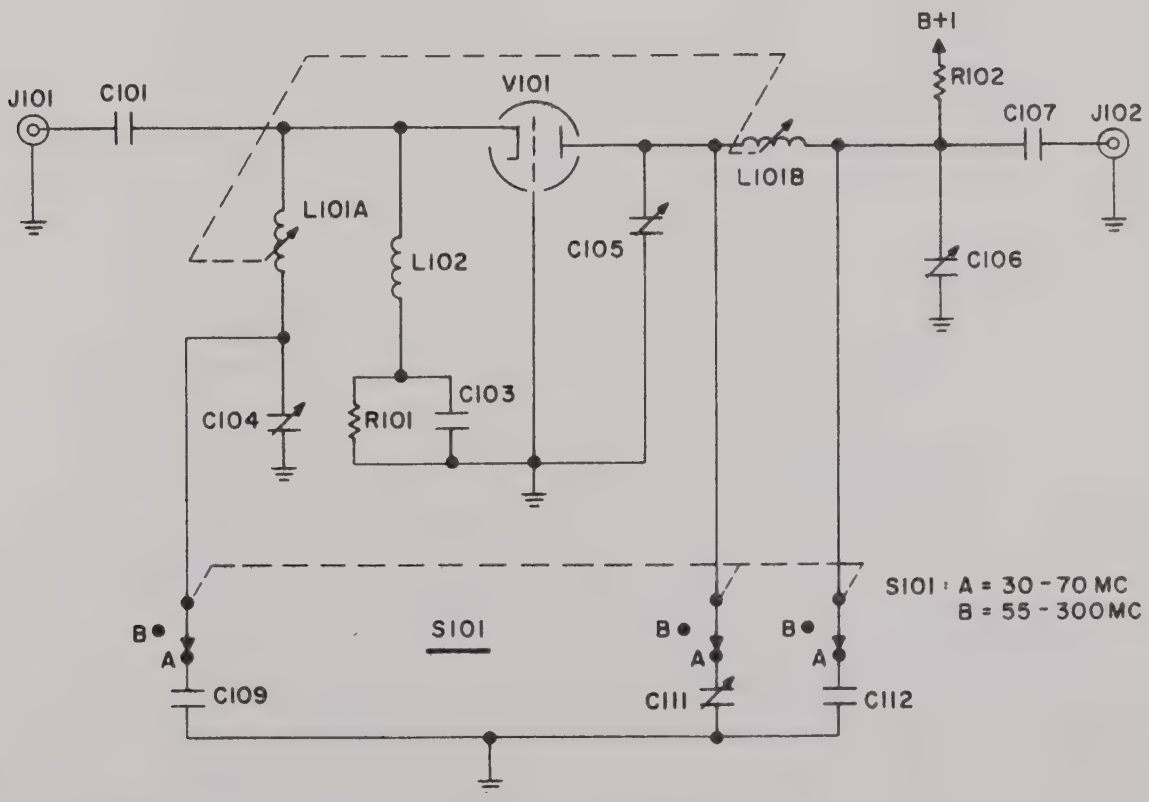


Figure 2-1 VHF Preamplifier Stage, Typical

J101 is the input connector. C101 blocks cathode bias from the input source. Cathode bias is developed across R101 which is by-passed

by C103 and isolated by L102. L101A, in conjunction with C104 and C109, serves to match the cathode impedance to the 50-ohm input line. The triode operates as a grounded-grid amplifier stage, and its plate circuit is matched to the 50-ohm output line by a pi-match circuit consisting of L101B, C105, C111, C106, and C112 R102 isolates the B+ supply and C107 blocks B+ voltage from the output. Tuning is accomplished by the turning of the front-panel knob, which controls ganged wipers making contact with the turns of the helically-wound tuning inductors (L101A, L101B, etc.)

A schematic circuit diagram of the entire preamplifier is shown in figure 2-3 on page 6.

2-2 POWER SUPPLY

A schematic diagram of the power supply is shown in figure 2-2.

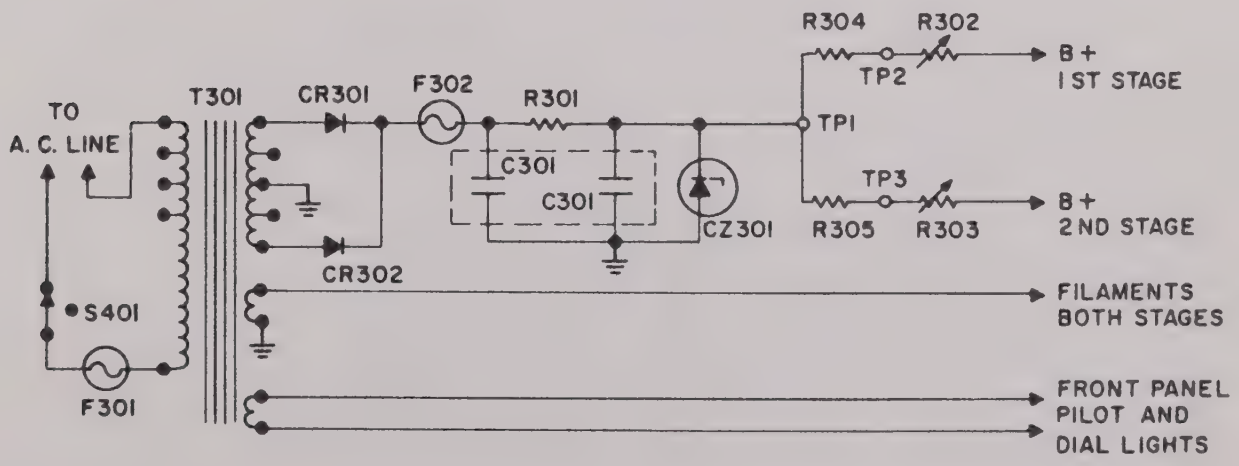
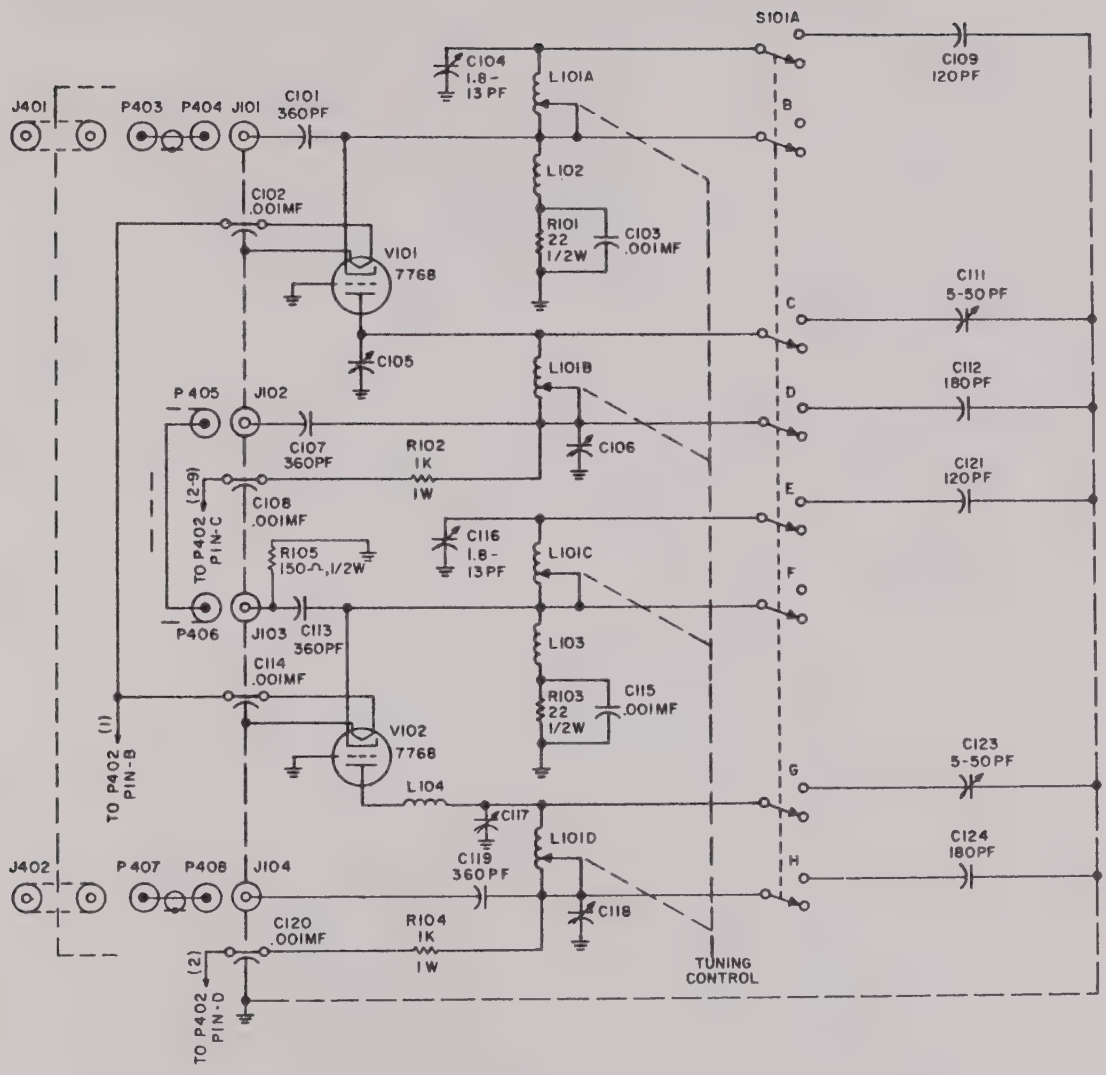


Figure 2-2 Power Supply Schematic Diagram

Power line voltage (95-125 VAC, 60 cps) is applied to T301 through S401, the power control switch located on the front panel, and F301, the primary power fuse located on the rear panel. T301 transforms line voltage to 400 VCT, for rectification at CR301 and CR302, and to 6.3 V for filament, pilot light and dial light supplies. Ripple filtering is provided by C301 and R301. R301 also drops the rectified voltage to the CZ301 zener voltage regulator. R302 and R303 are used to adjust plate current for 15 ma. to the first and second amplifier stages respectively. When R302 and R303 are properly adjusted for the 12-20 ma. plate current range in each amplifier stage, the voltage between test points TP1 and TP2 (across R304) and between test points TP1 and TP3 (across R305) is between 1.2 and 2 volts.

A diagram of the circuit of the power supply is shown in figure 2-4 on page 7.



NOTE:

1. L101 A THRU D ARE GANGED.
2. S101 A THRU H ARE GANGED.
3. C105, C106, C117, C118 ARE PART OF CHASSIS.
4. L102, L103 = APPROX 1 MICROHENRY OR 36 TURNS CLOSEWOUND NO. 32 ON 1/8 DIA. PIGTAIL FORM.
5. L104 = 3 TURNS # 22 TINNED WIRE SPACED 1/4" (TOTAL LENGTH) 3/32 I.D.
6. S101 BANDSWITCH SHOWN IN POSITION B. (55-300MC BAND)

Figure 2-3 Schematic Diagram, R.F. Section

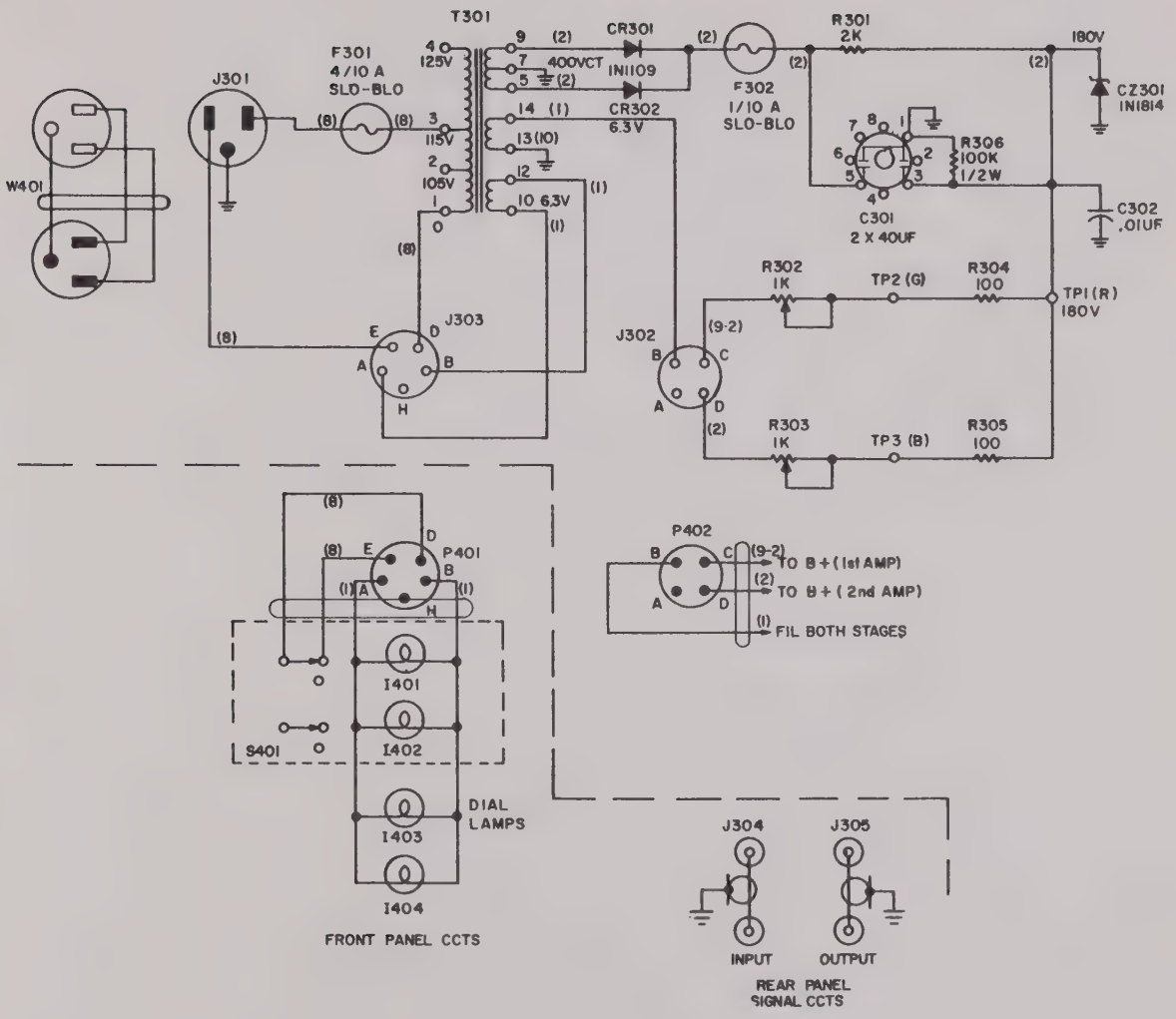


Figure 2-4 Schematic Diagram, Power Supply Section

SECTION 3 - OPERATION

3-1 SIGNAL CONNECTIONS

The AP-501R Preamplifier is provided with two sets of panel receptacles; one set on the front panel, and one set on the rear panel, enabling signal connections to be made at either (not both) the front or rear panels. Prior to installing the Preamplifier in an equipment rack the desired signal cable arrangement should be decided upon and the internal cables connected accordingly. (Remove the Preamplifier dust cover to check the connections of the input and output cables.)

3-2 POWER LINE VOLTAGES & TRANSFORMER TAPS

It is recommended that the available line voltage be measured and the primary tap on the Preamplifier power transformer be set to the closest available voltage tap (105, 115, 125 VAC) to ensure proper operation of the vacuum tube filaments. (This tap is set to 115 VAC at the factory.) To change the primary voltage tap, remove the dust cover, unsolder the grey lead from lug 3 of T301 and resolder this lead to lug 2 for 105 VAC (or below) or to lug 4 for 125 V (or above). This adjustment is necessary only in cases of long periods of operation or where peak performance of the amplifier is required. It should be remembered, however, that high filament voltage results in shortened tube life while excessively low voltage results in somewhat diminished gain and sensitivity.

After connecting the Preamplifier to a suitable power source, pressing the POWER button on the front panel should result in illumination of the POWER button and the dial lights. The amplifier is now ready to be connected to a signal source (INPUT) and receiver (OUT PUT).

3-3 TUNING

The BAND switch is used to set the preamplifier either to band A, (30 - 70 mc) or to band B, (55 - 300 mc).

Tuning of the preamplifier is accomplished by the manipulation of the tuning control knob. Adjustment of tuning to a given frequency is assisted by noting the position of the dial needle with respect to the calibrations of the appropriate frequency dial scale.

SECTION 4 - MAINTENANCE DATA

4-1 DC ADJUSTMENTS

All dc test points and adjustment controls are located on the rear panel.

CAUTION NOTE: All Test Points are at B+ potential above chassis.

The dc adjustment procedure is as follows:

1. Insert the positive probe of a dc voltmeter into testpoint TP1, and the negative probe into TP2. Reading should fall within the 1.2 volt range. Adjust by turning R303.

2. Remove the negative probe from TP2, insert it into TP3. Reading should fall within the 1.2 to 2 volt range. Adjust at R303.

4-2 FREQUENCY ALIGNMENT

NOTE: Frequency alignment should be preceded by dc adjustments (Para. 4-1).

The recommended method of frequency alignment of the AP-501R Preamplifier requires a sweep generator with frequency markers, two 10db coaxial attenuators (50-ohm), a wideband detector and an oscilloscope, arranged as in figure 4-1.

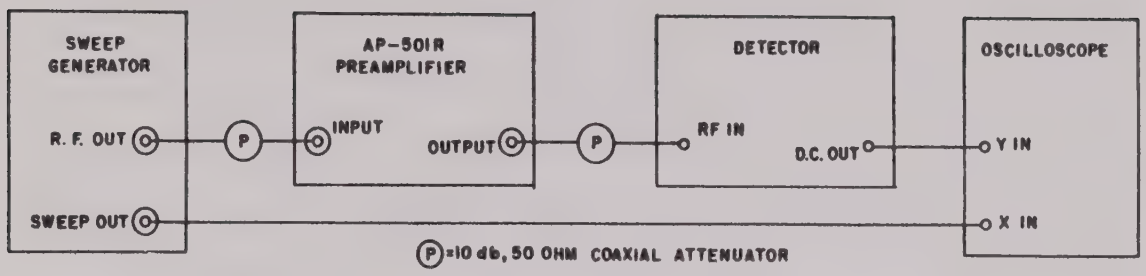


Figure 4-1 Equipment Arrangement for Frequency Alignment of AP-501R VHF Preamplifier

Frequency Alignment Procedure:

1. Turn Preamplifier bandswitch to band B.

2. Turn Preamplifier tuning knob to extreme clockwise position.

3. Adjust sweep generator for 300 mc. output and sweep width for 30 mc.

4. Adjust capacitors C106 and C118 for maximum scope deflection by bending the plates attached to L101.

5. Turn on marker oscillator and determine the center frequency of the amplifier response. It should be slightly above 300 mc (305 to 310 mc), and there should be no significant response peaks when the sweep

generator is increased above this frequency. Spurious response above 310 mc is prevented by capacitors C105 and C117. These capacitors are set at the factory and normally should not require readjustment. If alignment requires it, they are adjusted by bending toward or away from the triode mounting plate. From a low-capacity setting, their capacity is increased until spurious response above 310 mc is insignificant, consistent with maximum 300 mc gain.

6. With the amplifier centered at 300 mc, check the position of the AP-501R tuning dial needle. If necessary, reposition the dial needle to 300 mc by loosening the set screws on the dial needle traverse cable drive capstan and, while holding the tuning knob stationary, repositioning the capstan. Then tighten the setscrews.

7. Adjustments 1 through 6, above, should provide proper frequency alignment of band B. To ascertain that operation is proper, gradually decrease the Preamplifier frequency and follow the response peak by decreasing the sweep generator frequency. There should be no abrupt gain or bandwidth changes, or indication of instability. If such are present, check for improper assembly of shield panels and grounding screws, etc.

8. Position the Preamplifier bandswitch to band A.

9. Position the Preamplifier tuning to ~~70~~ 60 mc.

10. Adjust the sweep generator for ~~70~~ 60 mc center frequency and 5 mc sweep width.

11. Adjust capacitors C111 and C123 for maximum Y axis scope deflection.

12. Adjustments 8 through 11 above should provide proper frequency alignment; however, step 7 should be repeated for the 30-70 mc band.

4-3 SENSITIVITY ALIGNMENT

NOTE: Sensitivity alignment procedure should be preceded by the Frequency Alignment (Para. 4-2).

Steps 1 through 9, below, are performed in order to determine which of the two amplifier connections, as shown in figure 4-2 and 4-3, is to be employed as the input stage.

Proceed as follows:

1. Remove the equipment dust cover and the rf sub-chassis cover.

2. Arrange and connect the equipment as in figure 4-2.

3. Tune the Preamplifier and Receiver to 300 mc.

4. With the Noise Generator turned off, tune C104 for minimum receiver output.

5. Reconnect the Preamplifier as in figure 4-3.

6. Repeat step 3. Tunc C116 for minimum receiver output.

7. Turn on the Noise Generator and note the output required to double the receiver output power.

8. Repeat steps 2 and 3.

9. Repeat step 7. Retain the connection (4-2 or 4-3) that results in lowest noise figure.

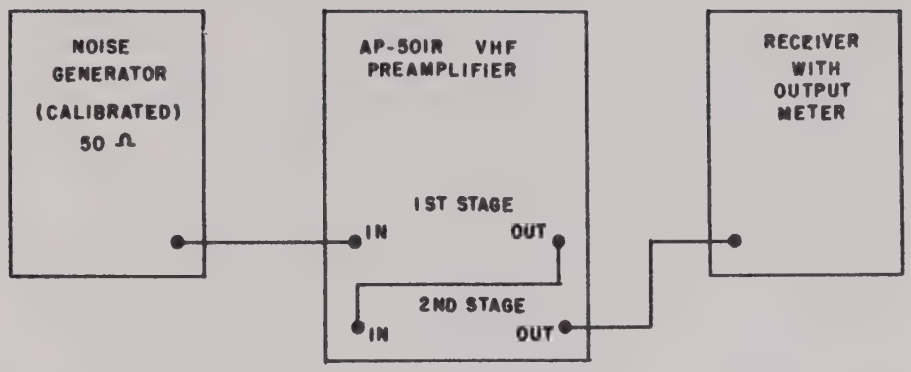


Figure 4-2 Sensitivity Alignment

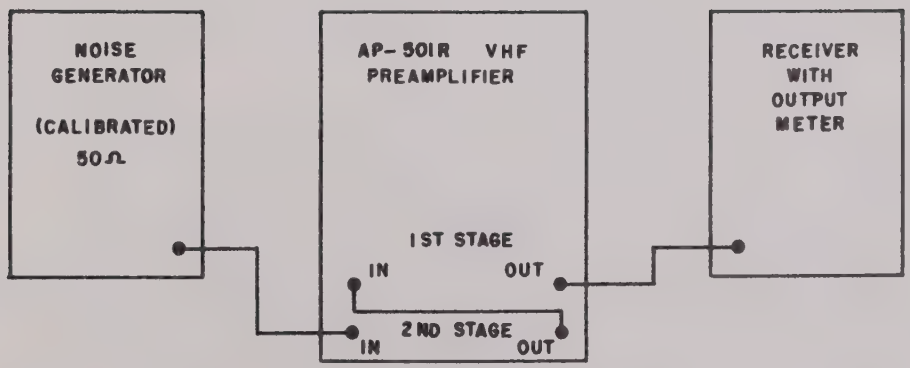


Figure 4-3 Sensitivity Alignment

NOTE: Noise figures of overall systems (i.e., preamplifier plus receiver) may be made by following the instructions of the manufacturer of the Noise Generator. However, sensitivity adjustments with the relationship

$$Fpa = Fo - \frac{Fr}{Gpa},$$

where Fpa = Noise factor of the Preamplifier

Fo = Noise factor of overall system

Fr = Noise factor of the receiver

Gpa = Power gain rates of the Preamplifier,

may not be made accurately unless Fr is low (nearly equal to Fpa). The noise figure specifications included in this instruction manual were measured under the aforementioned conditions.

4-4 TUBE REMOVAL AND REPLACEMENT

Faulty tubes will be indicated more by noisy operation or low preamplifier gain rather than by obvious changes in the dc potentials.

To replace tubes:

1. Remove dust cover and preamplifier sub-unit cover.
2. Pull the filament connectors from their respective pins.
3. Loosen the nuts on the nylon screws that extend between the grid and cathode partitions.

4. Grip the tube grid ring firmly with pliers and pull the tube from its mounting.

5. Remove and retain the anode pin adapter.

6. Place the anode pin adapter on the new tube, and gently push the tube into the mounting, taking care that the filament pins are aligned in the horizontal plane.

7. Reconnect the filament leads.

8. Turn on the power supply. After warm-up recheck the dc adjustments (Para. 4-1), R.F. Alignment (Para. 4-2) and Sensitivity Alignment (Para. 4-3).

Circuit Symbol Number	Description	Manufacturers Part No.
C101	Capacitor, Ceramicon, 360 pf, 600 V	ERIE GP-360
C102	Capacitor, feedthrough, .001 Mf	ERIE 327 x 50 102M
C103	Capacitor, Standoff .001 mf. 500 V	ERIE 662 003 102K
C104	Capacitor, Trimmer, 1.8-13 pf	E. J. Johnson, 189-6-5
C107	Same as C101	
C108	Same as C102	
C109	Capacitor, Silver Mica, 120 pf, 500V	ARCO DM-10-121J
C110	Deleted	
C111	Capacitor, Trimmer 5-50 pf	ERIE 503 34R
C112	Capacitor, Silver Mica, 500 V	ARCO DM-10-181J
C113	Same as C101	
C114	Same as C102	
C115	Same as C103	
C116	Same as C104	
C119	Same as C101	
C120	Same as C102	
C121	Same as C109	
C122	Deleted	
C123	Same as C111	
C124	Same as C112	
C301	Capacitor, Electrolytic, Octal plug-in, 2-40 Mf, 450 V	Aerovox AEP 88J
C302	Capacitor, Ceramic Disc. .01 Mf, 600 V	ERIE
CD401	Power Cord	Belden 17460-S
CR301	Rectifiers, Silicon	Sarkes-Tarzian IN1109
CR302	Same as CR301	
CZ301	Diode, Zener	Hoffman IN1814
F301	Fuse, Glass Cartridge, 4/10 a. 250 V, Slow-blow	Buss MDL 4/10
F302	Fuse, Glass Cartridge, 1/10 a. 250 V, Slow-blow	Buss MDL 1/10
I401	Pilot bulb, 6 V, T 1-3/4 bulb, Screw Base. Supplied P/O S401	Type 342 or 1768

Circuit Symbol Number	Description	Manufacturers Part No.
I402	Same as I401	
I403	Pilot bulb	Type 47
I404	Same as I403	
J101	Coaxial receptacle	Amphenol UG 1094/U
J102	Same as J101	
J103	Same as J101	
J104	Same as J101	
J301	Receptacle, Power, 3 cct	Amphenol 160-5
J302	Receptacle, 4 cct	Amphenol 126-215
J303	Receptacle, 5 cct	Amphenol 126-218
J304	Coaxial Receptacle	Amphenol UG 492A/U
J305	Same as J304	
J401	Same as J304	
J402	Same as J304	
L101	Inductuner, 4 stage, 2-3/8 in. Shaft	Mallory HT-204-1
L102	Inductor, 1 uhy	ACDC RFC-S-1.0
L103	Same as L102	
P401	Connector, 5 cct	Amphenol 126-217
P402	Connector, 4 cct	Amphenol 126-214
P403	Connector, Coaxial	Amphenol UG 88C/U
P404	Same as P403	
P405	Same as P403	
P406	Same as P403	
P407	Same as P403	
P408	Connector, Coaxial	Amphenol UG 913/U
R101	Resistor, CC, 22 ohms, 1/2W, 5%	
R102	Resistor, CC, 1000 ohms, 1W, 5%	
R103	Same as R101	
R104	Same as R102	
R105	Resistor, CC, 150 ohms, 1/2W, 5%	
R301	Resistor, WW 2000 ohms, 25W, 1%	
R302	Potentiometer, CC, 1000 ohms, 2W w/locking nut	Ohmite 53C2 (1000)
R303	Same as R302	
R304	Resistor, CC 100 ohm, 1/2W, 5%	

Circuit Symbol Number	Description	Manufacturers Part No.
R305	Same as R304	
R306	Resistor, CC, 100 K ohms, 1/2W, 5%	
S401	Power Switch, DPDT, Illuminated, Twinlight W/Barriers and lense (red)	Control's Co. of America, C6-57-R22
T301	Transformer, Power, Primary 105, 115, 125 V, 54-66 cps, Secondarys 200 or 400 VRMS-CT, .070a., 6.3v, 2a.	UTC M-593A
V101	Vacuum Tube, Ceramic triode	GE-7768
V102	Same as V101	
XC301	Octal Socket, Ceramic	ELCO 338 PHSPTD
XCR301	Fuse Clips, W/Solder lug	Littlefuse 121004
XCR302	Same as XCR301	
XV101	Fuse Clips, Earless	Littlefuse 121002
XV102	Same as XV101	
XF301	Fuse Holders	Buss HKP
XF302	Same as XF301	
XTP1	Tip Jack (red, green, and blue respectively)	H.H. Smith 1501-102, 1501-104, 1501-105 respectively
XTP2	Same as XTP1	
XTP3	Same as XTP1	
X1403	Pilot Light Holder	Dialco 705
X1404	Same as X1403	
	Tuning Knob	Raytheon 175-1-2G
	Bandswitch Knob	Raytheon 90-4-2G
	Bandswitch Index Assembly	Centralab P272
	Handles, Oval, black oxide finish	USECO 1017-14

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